Published by: INDUSTRIAL HYGIENE NEWS - May 2000

How Safe is Your Gas Detector?

By Ted Hardenbergh, Product Line Manager, Portable Instruments, Mine Safety Appliances Co.

You carry it with you every day so you can go home at night. OSHA's 29 CFR 1910.146 Permit Required Confined Spaces requires you to use it. You trust it. It's your gas detector. Surely it will not fail you when you rely on it to protect your life... or will it?

Gas detection equipment has improved a lot over the past several decades. Gas monitors were once complex pieces of equipment for use by highly trained technicians. Now, many are compact, hand-held devices that industrial workers use every day. Sophistication and ease of use have certainly come a long way. However, has it really improved your team's safety?

Looking beyond simple OSHA compliance, it is clear that some gas detectors provide a higher level of assurance that your workers will be alerted to the presence of dangerous gases. How does your monitor stack up? It is better to compare before it is too late.

This article is intended to help guide you through questions you may want to ask about your own gas detectors. If you and your workers have a clear understanding of your detector's operation and limitations, you can be well protected. Knowing in detail what your detector can and cannot do is of critical importance to worker safety.

Gas Exposure

The place to start when reviewing the safety of your gas detector is how it operates when exposed to gas. From latching alarms to alarms for longer-term exposure, there are a number of facets to how a detector design provides appropriate warning for workers exposed to hazardous gases.

Does your detector have latching alarms? A latching alarm is one that does not reset automatically when the alarm condition clears. It requires that the user acknowledge the alarm, for example, by pressing a button to reset it. This is important when a momentary alarm condition clears before the user can see what caused the alarm. Depending on the condition, you may want your team to take different actions. Having latching alarms allows them to know for certain if something is wrong.

Does your detector have a means to prevent alarms from being set too high? Most gas detectors allow the user to set the alarm levels. Does your detector have a limit to prevent the alarms from being set so high that the user will not be notified if there is an immediate danger?

Can you disable your detector's alarms? A device relied on to safely alert workers to the presence of hazardous gases should not be able to have its alarms fully disabled.

Does the detector prevent ambiguous readings when it reaches 100% of the Lower Explosive Limit (LEL)? A natural fact for all catalytic combustible gas detectors is that they can display erroneous low readings when exposed to very high concentrations of gas. Catalytic sensor output increases with increasing gas concentrations only up to a certain point. At very high (rich) concentrations, the catalytic sensor can no longer properly burn the mixture and the output declines. As a result, the reading displayed on a detector will drop. Therefore, if you are sampling into a remote area, you cannot be sure the low LEL reading is accurate unless the meter can protect against erroneous low readings. Some gas detectors account for this by locking into alarm when they reach 100% LEL. This helps assure that the user is not tricked into thinking an atmosphere is safe when indeed there is an extremely dangerous situation.

Does your monitor have STEL, TWA alarms? OSHA and the ACGIH have set limits on worker exposure to hazardous gases over periods of time. These are typically measured in 15-minute averages (STEL, or short-term exposure limit) or 8-hour averages (TWA or time-weighted average). Though not applicable in all situations, if workers are going to be in a potentially hazardous environment for longer periods of time, it makes sense for their gas detector to alert them if their exposures exceed the limits.

Sampling

In many situations, the user is required to draw a sample remotely from an area to help assure that the atmosphere is safe prior to entering. In this case, the safety and proper operation of the remote sampling system (electronic pump or manual aspirator) is critical.

The most crucial factor involves assuring the sample is being properly drawn from the remote area being monitored. Leaks in the sampling line or problems with the pump may lead the user to a false confidence in the safety of the atmosphere they are sampling. To guard against this, a simple check is recommended by most manufacturers: simply block the inlet of the sample line or probe and ensure the unit provides the proper alerts indicating blocked flow.

Does your monitor have adequate alerts for flow blockage? Beyond simply having an alert for blocked flow conditions (some products still have none!) the main item to review is how the user is alerted. Are they provided with both a visual and an audible alert that the gas flow is stopped? Without the proper alerts, the operator may never realize that there is no gas being supplied to the detector.

Does this alert function if the pump is clogged slowly? Another area of investigation is to assure that the blocked flow alarm operates when the flow is slowly choked off. Flow degradation can occur over time as filters and sample lines become choked with dust and debris.

Does the instrument detect if the pump is detached or jams? Does it provide any warning to the user if the pump module is inadvertently detached from the detector?

Are your sample lines compatible with the gases you are trying to detect? Many toxic gases, such as hydrogen sulfide and chlorine, are highly reactive and will not pass through or are not recommended for use with many types of tubing. For example, Tygon tubing will absorb certain toxic gases and is not recommended in many applications. If you have questions, ask your supplier for data assuring that your sample line can safely transport the gases you are interested in detecting.

Battery Packs

You work with your instrument battery packs every day. Yet, there are several features that can make a big difference in their ability to provide adequate protection in emergencies.

Can you change the battery pack in hazardous locations? This can be crucial for long-running jobs. While almost every industrial gas detector is approved for use in hazardous locations, few allow you to change or swap out battery packs on the job. If you want to be sure you can change packs on the fly, verify that your detector is approved to allow you to switch packs in hazardous locations. Otherwise, there is a very real explosion risk.

Do you know how long your instrument will run? Most gas detectors report battery condition as a simple voltage. Do you have any idea how long your instrument will run with a battery that is reporting "3.6 volts"? Probably not. Power management technologies have been incorporated into battery packs, allowing the instrument to display an accurate estimate of the remaining run time.

How much run time is left when batteries get low? One further concern regarding battery packs is whether they provide proper warning to the user when the charge is too low to continue instrument operation. In colder weather, battery packs lose a great deal of capacity. While you may be provided with a low-battery warning prior to the detector shutting off at moderate temperature, a battery pack's ability to provide an adequate warning may be dramatically reduced at colder temperatures. This could leave your workers unprotected on the job.

Re-Zeroing the Readings

In almost all cases, the sensors used in industrial gas detectors are subject to small amounts of zero drift. Most allows the user to easily reset the zero readings. While this is necessary to help assure accuracy, it is also possible that this feature may cause confusion or even create hazards in certain cases.

Does your detector have limits on zeroing? The major issue when re-zeroing a gas detector is assuring that the atmosphere used to reset the zeros is truly "fresh air." To protect against possibly zeroing out background gas, some detectors are programmed with limits on the zeroing function. There have been many instances where a user has "zeroed out" background concentrations of gas well above alarm limits!

What does your monitor do if you attempt to zero it in background gas? While perhaps not safety-critical, it is also very helpful to understand exactly what your monitor will do if zeroing is attempted with ground gas. There are meters that do everything from accepting the existing background as "zero", regardless of how far it is from the most recent zero point, to disabling the sensor readings for the given gas. It is important to select a meter that allows your users to easily understand what happens in this situation. Otherwise, you can waste much valuable time answering questions about instrument zero drift.

Calibration

The final key to obtaining accurate gas readings is calibration. As with many other gas detector features today, much work has gone into simplifying this procedure. There is still no substitute, from a safety standpoint, for having a well-trained technician manually adjust the reading of an instrument to a known concentration of gas. However, in this age of the microprocessor, the alternatives can be equally effective, given appropriate training.

Does the detector have appropriate levels of tamper resistance to prevent you from inadvertently entering calibration mode? One consideration when reviewing detector calibration safety is assurance that the level of tamper resistance is closely matched to the experience and training of the end-users. Provisions preventing inadvertent adjustments by untrained users may be of utmost importance to many companies. So, be sure to carefully consider your detector's "lockout" capabilities.

Does the autocalibration on your monitor have adequate safety limits? The greatest change in calibration in the last 5 years has been the advent of one-button typically allows the user to press a sequence of buttons to enter calibration. The instrument software then automatically adjusts the "span" readings to preset concentrations.

While very simple in use, this calibration procedure should be approached with caution. There are a number of problems that can arise when using this calibration method, from using the wrong gas to leaks in the connection between the gas cylinder and the instrument. It is possible with some detectors to apply more than three times the expected value and still have the instrument complete its calibration. This would lead to readings of ONE THIRD of the actual value!

The key to safe autocalibration is to ask the manufacturer what limits they have on the adjustments. Many manufacturers only provide protection against calibrating when NO gas is present. The results can be disastrous.

Can autocalibration be disabled? For some users, the ability to prevent unauthorized adjustments to the meter's calibration may be very important. Be sure to verify this capability if such protection is part of your safety program.

Does it have an automated calibration system available? Automated, computer-based calibration systems are becoming more common. From a safety standpoint, the main advantage of computer-based calibration systems is their repeatability. They can be less prone to individual user error and can help assure proper calibration of medium to large fleets of instruments. These systems can also be of great assistance in formal confined space programs by providing, in some cases, automatic storage of calibration records.

Approvals

No discussion of gas detection equipment would be complete without attention to intrinsic safety approvals. There are varying levels of approvals and you need to be assured that the approvals for your gas detectors match your applications.

Do your instrument approvals match the requirements for your job? There are different approval levels for different combustible environments. For instance, if you work in areas where there may be explosive dust (e.g., mines, grain silos) your monitor should be approved for Class II Division 1, Groups E, F and G - and not all are.

As noted previously, understanding the limitations of your gas detectors is

an effective safety program. Even though an instrument may not score well in all categories, that does not imply it cannot be used safely. Rather, you need to consider these factors in establishing your gas monitoring and confined space entry procedures.

As you can see, there are many features buried beneath the surface of your gas detector's housing which are of considerable importance to the safety of your workforce. Many of these you have likely considered but some you may not have. Be sure to ask about more than just the manufacturer's published specifications when selecting your next monitor. It can make all the difference in having everyone on your team go home tonight.

For additional information, contact MSA Instrument Div., Box 427, Pittsburgh, PA 15230, 724/776-8600, 800/672-4678, Fax: 724/776-3280

Use the following checklist/scorecard to evaluate your existing monitors. Even more importantly, use it as a guide to assist in the decision-making process during your next purchase of gas detection equipment.

Gas Detector Checklist/Scorecard

	Rating 9 = Excellent 3 = Adequate 1 = Poor	Weight 9 = Critical 3 = Important 1 = Not Important	Score = Rating x Weight
Gas Exposure			
Latching alarms?			
Limits on alarm setpoints?			
Alarms cannot be disabled?			
Prevents ambiguous LEL readings?			
STEL and TWA alarms if needed?			
Sampling Systems			
Alerts for flow blockage?			
Detects pump detachment or motor jammed?			
Sample lines compatible with gases to detect?			
Battery Packs			
Changeable in hazardous location?			
Do you know run time remaining?			
Adequate length of battery low warning?			
Setting Zeroes			
Limits on allowable background gas?			
Graceful "exit" if background gas detected?			
Calibration			
Acceptable level of tamper resistance?			
Limits on autocalibration gas expected vs gas read?			
Can autocalibration be disabled?			
Is an automated system available, if desired?			
Approvals			
Does it carry the necessary approvals for your application?			
	Total Score as compared to other detectors		